other divisions of the elements occur in the same manner and in quick succession, the cells will all soon be inclined to the right, and in like manner if the walls incline to the left, the cells will incline to the left. The elements of the wood will be inclined as those of the cambium are inclined.

In all of the specimens examined, if any twisting of the grain occurred during the first thirty years of the life of the tree, such twisting was found to be to the left. In about half of the specimens the twisting in this direction continued throughout the life of the tree. In the other half twisting did not make its appearance until well along in the life of the plant (then to the right) or changed from the left to the right in from thirty to one hundred twenty years. The inclination of the long axis of the elements from a radial plane varied from one to ninety degrees. In a little more than half of the specimens the angle of divergence increased regularly with the age of the tree.—L. S. CHENEY.

The mechanics of curvature.

The much vexed question of the curvature of organs in response to various stimuli is again to the front, and a slight advance in the solution of the chief problem, *i. e.*, the immediate cause of the curvature, may be claimed. Noll in a recent contribution[1] meets the specific objections offered to his previous work[2] by Kohl[3] and Pfeffer.[4]

The principal theories which have been successively advanced in explanation of curvatures are chiefly as follows: Sachs attributed it to the exaggerated growth in length of the tissues on the side whose surface became convex in outline; DeVries to an induced heightened turgor of the convex side; Wortmann, in 1887, to the thickenings of the membranes of the concave side and aggregation of protoplasm in the cells limited by them, and consequences in growth extension. In the large amount of critical work following this last contribution it was established that the migration of the protoplasm and the thickening of the membranes on the concave side were attendant upon but bore no causal relation to cur-

[1] Ueber die Mechanik der Reizkrümmungen. Flora **81:** 36–87. 1895.

[2] Beitrag zur Kenntnis der physikalischen Vorgänge, welche den Reizkrümmungen zu Grunde liegen. Arb. d. bot. Inst. z. Wurzburg **3:** 496. 1888.

[3] Die Mechanik der Reizkrümmumgen. Marburg. 1894.

[4] Energetik der Pflanzen. Leipsic. 1893.–Druck und Arbeitsleistungen durch wachsende Pflanzen. Leipsic. 1893.

vature. According to the results of Noll's recent researches it seems somewhat conclusively demonstrated that the stimulus induces an increased plastic and elastic extensibility of the longitudinal membranes of the side of the organ afterwards becoming convex through the activity of the protoplasm, that these membranes extend in length from the pressure of turgidity, which is equal throughout the entire cross section, but the membranes of the concave side are unaltered and do not respond farther to it. That the extension of the membranes of he convex sides is not growth is shown by the fact adduced by Noll that they not only become thinner during the extension but do not increase in dry weight. The alterations in the properties of the cell wall which permit the extension are accompanied by changed reactions to staining substances. The fixation of the elastically and plastically extended cell walls of a curved organ is compared to the vulcanization of a stretched membrane of india-rubber; the protoplasm produces a substance which "vulcanizes" the extended wall and prevents the reflexion of the old curvatures to the initial stature of the organ when plasmolysed.—D. T. MAC DOUGAL.

Selection of organic foods by plants.

In a recent article, Pfeffer[1] has taken up the question of selection by plants from organic foods offered. If two carbon-containing compounds, each of which is present in a quantity sufficient to completely satisfy the demand for this kind of food, be offered to a plant at the same time, will both of these substances, either of which is capable of replacing (and thus protecting) the other, be used; and if this protection takes place, to what degree does it occur?

The experiments were conducted exclusively with the lower fungi, in most cases with *Aspergillus niger* and *Penicillium glaucum.* In the first series of experiments, two carbon-containing compounds of rather unequal nutrient value, dextrose and glycerine, were added to the nutrient solution in various proportions and the fungi in pure cultures were cultivated therein. The general result was that a choice was exercised in taking up the necessary carbon-containing material. Both were somewhat used, but the better food, the dextrose,

[1] PFEFFER, W.: Ueber Election organischer Nährstoffe. Jahrb. f. wissensch. Bot. **28:** 205. 1895.